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(54) Golf balls of three piece structure

(57) A golf ball comprises a three part structure, namely an elastomeric core, an intermediate layer, and a thermoplastic outer envelope. The intermediate layer is made of a thermoplastic material containing at least 10% and preferably at least 35% by weight of a block copolyether.

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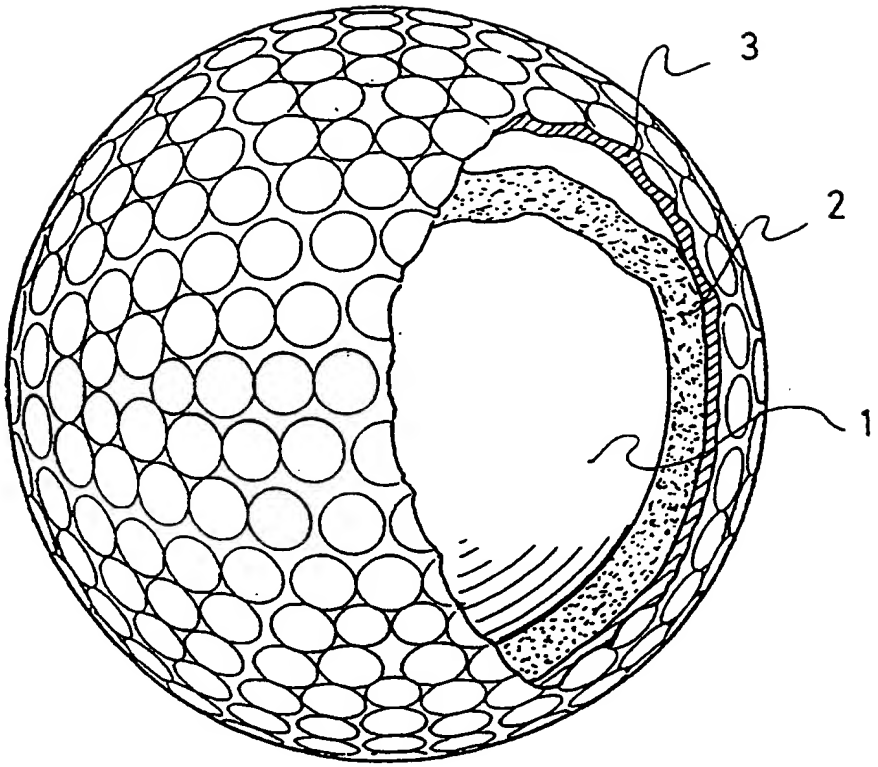
FIGURE DE L'ABREGE



GOLF BALL

This invention relates to golf balls and, more particularly, to golf balls having a three piece structure.

The prior art makes a distinction between two main types of golf ball. One of these is the solid so-called "two-piece" ball. Its properties result from the combination of a one-piece rubber spherical core and a hard thermoplastics envelope of ionomer resin. The main advantage of these balls is that they give very high performance in long drives because of their high starting speed. On the other hand they feel hard when hit, the essential cause of which is their significant rigidity. In short shots or approach shots, their high initial speed and the low contact area with the striking face reduces control of the ball and the lack of rotational speed has an adverse effect on the behaviour of the ball as it drops.

The other main type of golf ball is the so-called "three-piece" ball. These comprise a central solid or liquid core, a winding of rubber threads forming an intermediate layer, and a thermoplastics outer envelope, one or two millimeters thick, of ionomer resin or balata rubber. The greater deformability of the outer layers of this structure causes a feeling of softness on impact, due to the greater level of

compression, and there is also a larger contact area. Conversely this type of ball has a poorer performance in long shots, the opposite of "two piece" balls.

An object of this invention is to provide a golf ball having a structure such that its performance is satisfactory in all parts of the game, namely: an initially high speed, close to that of two piece balls, good feel and good control in the approach game, and also reproducibility of strike and excellent durability.

According to the present invention there is provided a golf ball which comprises a core of elastomeric material, an intermediate layer, and an outer envelope of thermoplastic material, in which the intermediate layer is made of a composition containing at least 10% by weight of a block copolyether, based on the total weight of the composition.

The intermediate layer preferably comprises at least 35% by weight of the block copolyether.

The block copolyethers used in the intermediate layer according to the invention are a known class of block copolymers comprising polyether blocks of a certain chain length and blocks derived from the other monomer or monomers. In the block copolymers used according to the present invention, the polyether blocks are flexible and the other blocks should be rigid. By varying the nature and proportions of these components a fairly wide range of products can be obtained, from the very flexible to the relatively rigid.

Of these copolymers, those which are particularly preferred are amide block copolyethers and ester block copolyethers. Suitable amide block copolymers (PEBA) are, for example, those available under the trade mark "Pebax" from Atochem; under the

trade mark "Grilamid" from EMS; and under the trade mark "Vestamid" from Huls.

Preferred ester block polyethers (PEBE) are those in which the ester blocks are derived from butylene terephthalate (PBT). Suitable block copolymers of this kind are, for example, those available under the trade mark "Hytrel" from du Pont and under the trade mark "Arnitel" from Akzo.

The intermediate layer may be formed wholly of the block copolyether. The resulting balls are valued for their excellent touch and their high initial speed. Conversely, because of a low elastic modulus they have a tendency to deform excessively on impact.

This problem is advantageously solved by using a mixture of the ether block copolymer and one or more ionomers. The proportion of ionomer(s) may be up to 90% by weight of the composition and is preferably from 20 to 65% by weight. Preferred ionomers are those having a Shore D hardness of from 55 to 65 and a bending modulus of from 250 to 350 N/mm2. In this case, the block copolymer is preferably an amide block polyether and is present in a proportion of from 35 to 80%; the amide block polyether is preferably one having a Shore D hardness of from 30 to 40.

For the better understanding of the invention, preferred embodiments thereof will now be described, by way of example, with reference to the accompanying drawing, in which the single figure is an elevation of a golf ball according to the invention, in partial cross-section.

Referring to the figure, the golf ball comprises a core 1 formed of a thermoplastic, thermo-hardened or vulcanisable elastomer and having a diameter of from 34 to 38 millimetres. Its density is from 1 to 1.3 g/cm3 and its Shore D hardness is from 40 to 50.

The compression of the core under a load of 150 kg is from approximately 2.8 to 4.5 mm for a fixed diameter of 36 mm.

Preferred elastomers for the core are cross-linked diene elastomers of the cis-1,4-polybutadiene type containing a reaction product based on zinc oxide and zinc diacrylate. The core composition also contains a cross-linking agent, for example dicumyl peroxide.

The intermediate layer 2 is an injectable and extrudable thermoplastic amide block polyether copolymer and, preferably, a polyetheresteramide of the kind described in French Patent 2,273,021.

By way of example, balls have been made with an intermediate layer of "Pebax" alone. Their characteristics and properties are shown in Table I and II below.

In a preferred embodiment, the intermediate layer 2 is formed of a mixture of amide block polyether and ionomer(s). Tables 3 and 4 show the characteristics and properties of balls having intermediate layers formed of mixtures of "Pebax" 3533 and "Escor".

In general, the layer 2 has a thickness of approximately 1 to 3 mm and an elastic modulus of from 15 to 255 N/mm2. Depending on the type of copolymer used, the Shore D hardness may vary from 25 to 50. The effect of these parameters is important and governs the performance characteristics of the ball. Balls having an intermediate layer with a low Shore D hardness of about 30 to 37 (low bending modulus) are valued for their touch and their control because of their high rotational speed or spin. Conversely, balls in which the Shore D hardness of the intermediate layer is from 40 to 50 (bending modulus also higher) are valued for

their optimum initial speed and their durability.

If Tables I and III are compared, it will be noted that the hardness values do not change if an ionomer is added to the ether block copolymer. Conversely, the modulus of elasticity under tension increases considerably. This effect is particularly useful because the intermediate layer contributes to the mechanical strength of the core on impact and advantageously restricts its deformation. The intermediate layer behaves dynamically like the wound elastic filament layer of so-called "wound" balls.

The assembly of the two parts 1 and 2 forming the internal structure of the ball has a compression under 150 kg of 2.5 to 4 mm for a total diameter of 40 mm.

Outer layer 3 forms the envelope for the ball. It is made of a thermoplastics material and has a thickness of from 0.9 to 3 mm.

The choice of materials is relatively wide in so far as the essential qualities required of the envelope are its impact resistance and durability. To obtain these characteristics, it is generally required that the hardness of the envelope should be greater than the hardness of the intermediate layer.

Suitable Shore D hardnesses for the envelope are, for example, from 40 to 55 and preferably from 43 to 48; the density of the envelope is preferably from 0.8 to 1.2 g/cm3 and the bending modulus is preferably from 30 to 280 N/mm3.

Preferred envelope materials are "Surlyn" ionomers available from du Pont and "Iotek" ionomers available from Exxon; amide block copolymers of the same type as those used for the intermediate layer, but of greater hardness; mixtures of ionomers and amide block copolymers; thermoplastic polyurethanes; and

mixtures of two or more of these materials.

The combination of the three components 1, 2 and 3 gives rise to a finished ball having a diameter of from 42.7 to 42.8 mm. Its compression under a load of 150 kg is from 2.5 to 4 mm.

By way of example, the physical and behavioural characteristics and properties of several balls according to this invention have been compared with balls according to the prior art in common commercial use. The results are shown in Tables I to IV below:

TABLE I

COMPOSITION	INVENTION				PRIOR ART		
	Ball 01	Ball 02	Ball 03	Ball 04	2-Piece Ball	3- Piece Ball	
						A	B
	CIS-1,4-POLYBUTADINE ELASTOMER CORE						
Diameter (mm)	36.4	36.4	36.4	36.4	SOLID RUBBER CORE	WOUND CORE	WOUND CORE
Density (g/cm3)	1.18	1.18	1.18	1.18			
Compression in mm under a constant load of 150 Kg	3.8	3.8	3.8	3.8			
COMPOSITION	AMIDE BLOCK COPOLYETHER (PEBAX) INTERMEDIATE LAYER						
Hardness (Shore D)	37	37	40	43			
Thickness (mm)	1.8	1.8	1.8	1.8			
Density (g/cm3)	1.01	1.01	1.01	1.01			
Elastic Modulus (N/mm2) under tension	40	40	55	80			
COMPOSITION	THERMOPLASTIC ENVELOPE				SURLYN ENVELOPE	SURLYN ENVELOPE	BALATA ENVELOPE
Hardness (Shore D)	43	45	45	47			
Thickness (mm)	1.35	1.35	1.35	1.35			
Density (g/cm3)	1	1	1	1			
Elastic modulus (N/mm2) under tension	80	100	100	120			

TABLE II

	INVENTION				PRIOR ART		
	Ball 01	Ball 02	Ball 03	Ball 04	2-Piece Ball	3-Piece Ball	
						A	B
Diameter (mm)	42.7	42.7	42.7	42.7	42.7	42.7	42.7
Weight (g)	45.4	45.4	45.5	45.4	45.5	45.4	45.3
Compression (mm)	3.7	3.6	3.4	3.1	2.8	3.3	3.2
DRIVER							
Initial Speed (m/s)	64.2	64.1	64.2	64.4	64.7	64.3	64.2
Spin (rpm)	3800	3650	3600	3300	2900	3300	3700
5 IRON							
Spin (rpm)	7500	7300	7300	6800	5600	6500	7300
PROPERTIES							
Control	G	G	E	E	M	G	E
Feel	G	G	E	G	M	G	E
Durability	G	G	G	G	E	G	M
Reproducability	E	E	E	E	G	M	M

E=Excellent G=Good M=Mediocre

TABLE III

	Ball 05	Ball 06	Ball 07
COMPOSITION	CIS-1,4-POLYBUTADIENE ELASTOMER CORE		
Diameter (mm)	36.4	36.4	36.4
Density (g/cm3)	1.18	1.18	1.18
Compression in mm under 150kg	3.8	3.8	3.8
COMPOSITION	INTERMEDIATE LAYER (PEBA/IONOMER)		
Hardness (Shore D)	37	40	43
Thickness (mm)	1.8	1.8	1.8
Density (g/cm3)	1	1	1
Elastic Modulus (N/mm2) under tension	90	120	150
COMPOSITION	THERMOPLASTIC ENVELOPE		
Hardness (Shore D)	43	45	47
Thickness (mm)	1.35	1.35	1.35
Density (g/cm3)	1	1	1
Elastic Modulus (N/mm2) under tension	90	100	120

TABLE IV

	Ball 05	Ball 06	Ball 07
Diameter (mm)	42.7	42.7	42.7
Weight (g)	45.4	45.4	45.4
DRIVER (46 m/s)			
Initial speed (m/s)	64.2	64.3	64.2
Spin (rpm)	3800	3600	3400
5 IRON			
Spin (rpm)	7500	7300	6900
PROPERTIES:			
Control	E	E	G
Feel	G	E	G
Durability	G	G	G
Reproducability	E	E	E

Claims:

1. A golf ball which comprises a core of elastomeric material, an intermediate layer, and an outer envelope of thermoplastic material, in which the intermediate layer is made of a composition containing at least 10% by weight of a block copolyether, based on the total weight of the composition.

2. A golf ball according to claim 1, in which the intermediate layer composition comprises at least 35% by weight of the block copolyether.

3. A golf ball according to claim 1 or 2, in which the block copolyether is an amide block copolyether.

4. A golf ball according to claim 3, in which the amide block copolyether is a polyetheresteramide.

5. A golf ball according to any of claims 1 to 4, in which the intermediate layer composition consists of a mixture of the block copolyether and at least one ionomer.

6. A golf ball according to claim 5, in which the composition contains up to 90% by weight of one or more ionomers having a Shore D hardness of from 55 to 65 and a bending modulus of from 250 to 350 N/mm^2.

7. A golf ball according to claim 6, in which the composition contains from 20 to 65% by weight of said ionomer(s).

8. A golf ball according to claim 7, in which the intermediate layer composition contains 35 to 80% by weight of an amide block polyether having a Shore D hardness of from 30 to 40.

9. A golf ball according to any of claims 1 to 6,having the following physical and dimensional characteristics:

diameter of core- 34-38 mm
diameter of core + intermediate layer- 37-41 mm
diameter of whole ball-42.7-42.8 mm
thickness of intermediate layer-1-3 mm
thickness of envelope-0.9-3 mm
compression of core having a 36 mm diameter under a load of 150kg-2.8-4.5 mm
compression of core + intermediate layer having a 40 mm diameter under a load of 150 kg-2.5-4.0 mm
compression of whole ball under a load of 150 kg-2.5-4.0 mm
elastic modulus (ASTM) of intermediate layer-15-250 N/mm^2
elastic modulus (ASTM) of envelope-30-280 N/mm^2.

10. A golf ball according to any of claims 1 to 9, in which the core comprises a cross-linked elastomer of the diene type.

11. A golf ball according to claim 10, in which the elastomer is based on cis-1,4-polybutadiene.

12. A golf ball according to any of claims 1 to 11, in which the Shore D hardness of the core is from 40 to 50.

13. A golf ball according to any of claims 1 to 12, in which the hardness of the envelope is greater than that of the intermediate layer.

14. A golf ball according to claim 13, in which the Shore D hardness of the intermediate layer is from 25 to 50.

15. A gold ball according to claim 13 or 14, in which the Shore D hardness of the envelope is from 40 to 55.

16. A golf ball according to claim 15, in which the Shore D hardness of the envelope is from 43 to 48.

17. A gold ball according to any of claims 1 to 16, in which the envelope is made of an ionomer, an amide block copolyether, a mixture of an ionomer and an amide block copolyether, a thermoplastic polyurethane, or a mixture of two or more of these materials.

18. A golf ball substantially as herein described with reference to any of Balls 01-07 of the Examples.

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